

NASA ADVISORY COUNCIL

HELIOPHYSICS SUBCOMMITTEE

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MEETING MINUTES



Maura Hagan, Chair



Elaine Denning, Acting Executive Secretary

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Tuesday, September 23, 2014

Welcome and Overview

Dr. Maura Hagan, Chair of the Heliophysics Subcommittee (HPS), opened the meeting. Ms. Elaine Denning, filling in as HPS Executive Secretary for Dr. Ramona Kessel, made some administrative remarks and provided background on the guidelines for Federal Advisory Committee Act (FACA) meetings, and subcommittee rules regarding conflicts of interest. Introductions were made around the table.

Discussion of Agenda

Dr. Hagan introduced the agenda, which would focus largely upon NASA's annual Government Performance Results Act Modification Act (GPRAMA) assessment, detailed information on low-cost access to space (LCAS) activities, as well as the newly established Education and Communication program (E&C), formerly known as Education and Public Outreach (EPO).

Heliophysics Division Overview

Dr. Newmark, Heliophysics Division (HPD) Director, provided an overview of progress within the division. The Magnetospheric Multiscale (MMS) mission launch is scheduled to occur on March 12, 2015. Thus far, the mission is going very well, and the spacecraft has just finished its final comprehensive performance testing. HPD will be shipping stacks to the launchpad in October and November. The Space Environment Testbed (SET) mission is scheduled to launch on a Department of Defense (DoD) satellite outfitted with an ESPA ring halo in mid-2016. SET is part of a series of small solid-state experiments meant to provide technology demonstration for space weather measurements. Solar Probe Plus (SPP) is due to launch in July 2018 and is going well. For the European Space Agency (ESA)/NASA collaborative mission Solar Orbiter (SO), NASA is holding an internal launch commitment date of October 2018, while the ESA launch commitment date is July 2017. If ESA is delayed, the launch will be pushed off for 14 months due to celestial mechanics (Venus gravity-assist). The new Explorer missions Ionospheric Connection Explorer (ICON), a full mission, and Global-scale Observations of the Limb and Disk (GOLD), a mission of opportunity (MoO), will be launching in 2017.

HPD continues its series of sounding rocket and balloon launches; over the last year, 19 sounding rockets have been launched, roughly half of which have been from HPD, and half from the Astrophysics Division (APD), as well as one planetary launch (Venus). BARREL, a two-campaign series of balloons launched from Antarctica, was designed to work in tandem with the Van Allen probes. Twenty balloons were launched in each campaign; science results are still being released. The Solar Terrestrial Probe (STP)-5 Announcement of Opportunity (AO) will be released no earlier than fiscal year 2017 (FY17). The ICON and GOLD missions will observe the ionosphere from two perspectives, using both *in situ* and remote sensing. The next Explorer AO is likely to occur in FY17, based on the outcome of the FY15 budget. The timing may change with the release of the FY16 budget. A Continuing Resolution is not expected to affect this schedule. HPD's intention is to enhance the cadence of the Explorer program and revitalize the research as recommended per the Decadal Survey (DS), and expects that starting in 2017, a three-year

cadence will be adopted for the Explorer schedule. NASA recognizes that this represents a big gap in launches, but it is an acknowledged budget reality.

Dr. Newmark mentioned some upcoming milestones: Key Decision Point-C (KDP-C), a key event for a mission, will take place for both ICON and GOLD in October and December, respectively. GOLD's KDP-C may slip to January. Solar Probe Plus (SPP) will go to Critical Design Review (CDR) in March 2015; its budget and schedule are fixed at \$1.553B. Other highlights include the announcement that the American Geophysical Union (AGU) fellows for 2014 include several members of HPD. Dr. Ed Stone has continued to be an eloquent spokesman for the Voyager mission. Dr. David McComas recently received an award from the Committee on Space Research (COSPAR). Goddard Space Flight Center's (GSFC) Dr. Diego Janches has received the honor of having had an asteroid named for him, and young investigators Wen Li and Toshi Nishimura have also been recognized for their work on the Time History of Events and Macroscale Interactions during Substorms (THEMIS) mission.

Dr. Spiro Antiochos asked Dr. Newmark whether he was comfortable with the amount of science funding available for MMS and the Solar Orbiter Collaboration (SOC). Dr. Newmark responded that while one can always use more money to support great science, the teams had been given the amounts they requested. Some teams should ask for more money when they can, as they often seem to sell themselves short. There is absolutely more science that these teams can do -- in phase E it is also about the community doing science with the missions. A dedicated Guest Investigator (GI) program has been recommended by the Decadal Survey, and it is hoped that HPD can carry out this recommendation. The division is additionally committed to augmenting the GI program moving forward, helping the larger community to lend new eyes to the data. Dr. Antiochos noted that synergistic work between SPP and SOC needs to be established. Dr. Newmark agreed, adding that HPD should have the science covered in the 2018-20 timeframe. Dr. Hagan asked if there would be any fluidity in the portfolio after MMS to begin to work on the Diversify, Realize, Integrate, Venture, Educate (DRIVE) initiative. Dr. Newmark anticipated that HPD would have a very small amount of funding in 2015/16 for an uptick. Dr. Vassilis Angelopoulos commented that putting money into research supporting the whole-system observatory will be critical. Dr. Newmark agreed with this assessment.

Dr. Newmark presented science highlights, including data obtained from both the Solar TERrestrial Relations Observatory (STEREO) and the Solar Dynamic Orbiter (SDO) revealing how the Sun releases a rare isotope of helium, as well as dramatic comet ISON observations and imagery from the Solar and Heliospheric Observatory (SOHO). The Van Allen Probes and THEMIS data provided new observations on the magnetotail. A sounding rocket launch provided some fundamental physics data on nanoflares, and best-ever NASA observations of an X-flare were obtained from four spacecraft. STEREO and the MErcury Surface, Space ENvironment, GEochemistry, and Ranging (MESSENGER) mission are both looking at solar neutrons. Voyager 1 measured a shock wave from the Sun. The Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft entered Mars orbit this past week, offering a key partnership for looking at an extraterrestrial ionosphere. A MAVEN Program Scientist will be coming to HPD in June, illustrating that there is important work to be done across divisions. The Interstellar Boundary Explorer (IBEX) is helping to paint a picture of the magnetic system beyond the solar wind, and THEMIS has discovered a new process that protects Earth from space weather. A sounding rocket was launched from

an Alaska site into an aurora, and more results from the Aeronomy of Ice in the Mesosphere (AIM) satellite on that indicate that data on noctilucent clouds provide a link between weather and climate.

Flight Program Status

Ms. Sandra Smalley, HPD Deputy Director, presented a status of the HPD flight program. One change of note is that ICON has been directed to take on an ion-velocity detector, and its launch date has been changed to June 2017 in order to fly in conjunction with GOLD, thereby leveraging operations and enhancing science results. GOLD is currently rated as yellow, and is delaying its Preliminary Design Review (PDR) because of a mass and power increase projection. The mission is looking to mitigate the increase by reducing mass on the instrument, and is discussing a rough order of magnitude (ROM) letter. ICON is in good shape and has passed its PDR, and is approaching its KDP-C milestone. SPP is green. SOC is mitigating a high-voltage supply issue. MMS is green. Dr. Antiochos asked if a delay on the ESA side of SPP would affect NASA. Ms. Smalley responded that it is possible, but NASA still intends to deliver instruments in October 2018; HPD has the funds and resources for SPP as long as it does not slip beyond October 2018. Dr. Newmark concurred with this assessment, adding that there is a lot of slack in the schedule because of the 14-month lag between launch windows. There is no reason NASA wouldn't be ready to launch in 2015.

At present, all operating missions are green. The STEREO head is currently in sun-avoidance operations, or basically storage mode. The mission is still able to get information out of the side lobes, but at a reduced data rate. The US Air Force has continued funding for the Coupled Ion-Neutral Dynamics Investigations (CINDI) mission. It has been determined that the SDO spectrometry failure will not preclude a recovery of all the science. SPP was confirmed in March; one of its key accomplishments was to develop its Thermal Protection System to Technology Readiness Level 6 (TRL-6). SPP is currently undergoing engineering design reviews as well as thermal testing of the antennas. NASA continues on track to providing two instruments for SOC. Eight of 10 instruments on the ESA side have passed CDR, and NASA has contracted for the Atlas launch vehicle.

MMS has made significant progress despite a minor conflict with thermal vacuum (t-vac) chamber testing schedules. The Naval Research Laboratory provided t-vac testing for Observatory #3, enabling all 4 observatories to have completed comprehensive testing. The MMS Pre-Shipment Review (PSR) will take place in October, and the Heliophysics Senior Review draft call is out. Sounding Rocket Hall (a precursor to Sounding Rocket Conde) was launched on 28 August and experienced some technical difficulties; the plan is to try to stay on schedule for Conde nonetheless. HPD is also conducting a Program Implementation Review on the Explorer program, Living With a Star (LWS) and Solar Terrestrial Probes (STP), in order to determine whether process improvements are necessary to ensure that programs are operating efficiently, particularly in light of recent Program Executive (PE) and Division Director transitions.

Discussion

Dr. Angelopoulos raised the issue of balance between small and large missions, suggesting perhaps that the issue could be approached with metrics that indicate how the balance of resources has been changing

over the years. By documenting history, one might be able to determine how to move forward in an actionable way in the 2017/18 timeframe. Dr. Antiochos noted that the DS had recommended specific numbers, and that a metrics approach should be possible. Dr. Hagan added that the Heliophysics Roadmap offers more recent data on allocation of resources to Research and Analysis (R&A), noting that the HPS remains concerned about program balance. Dr. Newmark agreed with the DS and Roadmap recommendations on a rebalance of the program, as more of a 50/50 split between large and small missions. Starting in late 2019, after two large missions have launched, HPD will be prepared to begin its five-year budget planning and re-balance the program accordingly. Dr. Michael Liemohn asked: do we break this down by papers per dollar? Is a 50/50 split ideal or arbitrary? Dr. Newmark responded that in terms of developing new missions, the DS identified some important science targets over the next 10-15 years; HPD wants to look at innovative and cost-effective ways to study these targets; this will drive the balance of mission sizes. Mission balance doesn't mean that x amount of dollars is required to obtain the desired data. It's a constant evolution of methods to study key targets. Dr. Ralph McNutt mentioned papers and citation metrics that were used in a similar exercise in the Planetary Science Division (PSD), which used H factors to come up with mission impact metrics rather than researcher impact. He felt there were all sorts of tripwires to such an approach, however. Dr. Antiochos noted that an historical assessment would reveal a gradual shift to large missions, adding that funding levels of the R&A program are most problematic; HPD is at 10%, whereas the figure is 20% for other divisions. Dr. Mihir Desai commented that it could also be useful to look at the cost growth in missions.

Discussion with SMD Associate Administrator

The subcommittee engaged in discussion with the Science Mission Directorate (SMD) Associate Administrator (AA) Dr. John Grunsfeld. Dr. Grunsfeld noted that MMS is making great progress, and everyone is anxious to get it launched. For SPP, all indications are it is doing well. More groups are entering the CubeSat arena, and have been the subject of recent briefings, including interplanetary CubeSats. Dr. Grunsfeld still felt it would be possible to have sensor nets around the Earth to sense coronal mass injections (CMEs). HPD is under budget pressure, but is trying to get the DRIVE initiative up and running as best it can. Dr. Antiochos asked how a Continuing Resolution and FY14 levels would affect HPD. Dr. Grunsfeld felt that the highest probability is that there will be a lame duck session, but the big question will be what happens in the Senate. He felt that current indicators actually boded reasonably well, and that there should be a healthy NASA budget through December. Dr. Desai asked if there were an agency-wide collaboration on smallsats and CubeSats. Dr. Grunsfeld noted that for terrestrial applications at low-Earth orbit (LEO), there is a CubeSat initiative launching from the International Space Station (ISS), but that there was an Agency emphasis to take advantage of new opportunities. To that end, SMD has tried to include CubeSats in every competitive call. It is a balance of risk and cost. It's less expensive to build a CubeSat to launch from ISS than it is to build an instrument and test it through the requisite TRLs. CubeSats are also valuable for training new scientists; the Earth Science Division (ESD) recently selected two Earth Science projects for this very purpose.

Dr. Kent Tobiska asked if there was a prospect of rebalancing resources between different divisions, referencing recent GSFC and Armstrong flight projects. Dr. Grunsfeld explained that this recent effort, the Hands-On Project Experience (HOPE) program, is a NASA competitive workforce development activity and is more for training employees. The center provides matching funds for activities such as the

Radiation Dosimetry Experiment (Rad-X), e.g., to determine what kind of radiation doses flight crews are getting. The prime mission was to develop a balloon to measure radiation, and to get an underflight from the Armstrong center to provide complementary data. Dr. Jeffrey Hughes asked about the status of HPD within SMD and Dr. Grunsfeld's vision of its future. Dr. Grunsfeld noted that the SMD divisions largely are accounting bins for management; but the science of the divisions is intertwined. He felt that the current management structure works well, and that performance metrics include how well the divisions work in an interdisciplinary way. In the meantime, he has been trying to combat the diminished budget for science, which is down \$6-8B over the last decade. Division by division, APD and HPD budgets have been declining over time, while ESD has dramatically increased due to climate concerns. Dr. Grunsfeld felt that in the 2020s, mitigation due to climate change will continue. ESD is also tasked with various measurements from the National Oceanic and Atmospheric Administration (NOAA), which will induce more pressure on its division. PSD has taken great cuts. There will continue to be pressure on science overall. He felt it was unlikely to have either a large or small decrease in funding. In HPD, the Agency has already cut through all the muscle. Dr. Hughes commented that the community is worried about long-term leadership in the HPD. Dr. Grunsfeld indicated that a search is under way for a new Division Director, and welcomed any input from HPS. He mentioned however that it is a challenge to be selected for a Senior Executive Service (SES) position; a candidate must be able to function as a senior executive in any branch of the government.

Dr. Russell raised the matter of diminishing success rates on proposals. Dr. Grunsfeld replied that NASA is running the numbers on all the divisions right now. The success rate is low because the number of proposals has increased. University funding also has decreased. There is no good solution at the moment. He has asked Marc Allen to consider a two-step proposal process in order to save investigators some time by shortening the word count on the first step. This could reduce the amount of time researchers spend in writing proposals. Dr. Newmark noted that he had some briefing material on this issue if HPS wishes to hear it.

Heliophysics Science Performance Assessment

Dr. Kessel provided a background on how HPS was to carry out the HPD science performance assessment as required by the Government Performance and Results Act Modernization Act (GPRAMA). The point of the exercise is to help NASA assess whether it is meeting its strategic goals, essentially by vetting its science results. HPD has completed a number of its strategic goals according to its latest performance indicators (mission results and research performed by NASA). Currently there are three annual performance goals in the NASA budget, which HPS is being asked to assess by deciding which of the 2 or 3 largest events or discoveries best support progress in meeting the science performance goals. GPRAMA asks that the subcommittee assess HPD's key accomplishments and disappointments, and to document high-level assessments with a color grade, accompanied by a short explanatory text as to why the grade was assigned.

Dr. Kessel addressed the overlap of goals and objectives and how these might affect selections. In particular, she explained that the report is targeted to an educated layperson (non-scientists). In principle

the report is for the taxpayers, but the actual audience is Congress, OMB, and other agencies in the Federal government.

Subcommittee Work Session

HPS divided itself into three subgroups to discuss the three performance goals under review:

API HE-14-1 Demonstrate planned progress in exploring the physical processes in the space environment from Sun to Earth and throughout the solar system.

API HE-14-4 Demonstrate planned progress in advancing understanding of the connections that link the Sun, Earth and planetary space environments, and the outer reaches of the solar system.

API HE-14-7 Demonstrate planned progress in developing the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

Lunch Talk

The subcommittee listened to a talk given by Dr. Sasha Ukhorskiy, entitled “Rotationally Driven ‘Zebra Stripes’ in Earth’s Inner Electron Belt,” based on data obtained from the Van Allen probes. Dr. Ukhorskiy reported that his group is actively talking with JAXA’s complementary Exploration of energization and Radiation in Geospace (ERG) mission, which is due to launch in 2016.

Subcommittee Work Session

HPS continued its GPRAMA work session.

LCAS Strategic and Budgetary Priorities

Dr. Newmark provided an overview of the SMD Suborbital research program, which uses a variety of assets including suborbital reusable launch vehicles, aircraft, balloons, sounding rockets (SRs), CubeSats, and launches of small instruments from the ISS. The purpose of the program is to power scientific discovery and technological innovation. The Suborbital program provides hands-on training for young scientists, quick turnaround on projects and missions, and the provision of new technologies at low cost (under \$10M). Many orbital missions now flying can trace their origins back to the Suborbital program, e.g., RHESSI. When using the ISS platform, a division provides the payload and Human Exploration and Operations Mission Directorate (HEOMD) provides support. HPD has not flown any payloads yet on ISS. ESD has used ISS in several instances, and APD is planning to do so.

The Suborbital program is for use by all of SMD. Balloons are managed by APD. HPD manages sounding rockets and CubeSats for SMD. There are roughly 18-20 sounding rocket launches per year, and the individual divisions pay for their payloads. Approximately \$50M per year is allocated for the management of the sounding rocket program; this pays for infrastructure, rocket motors (Black Brant), as well as full time equivalent (FTE) and contractor costs. HPD now manages the CubeSat program for all of SMD, which is currently funded at \$5M per year for payloads, and is accessible through the LCAS program. To date, there has been no cost-sharing with the Space Technology Mission Directorate

(STMD) on CubeSats, but NASA has partnered with the National Science Foundation (NSF). Dr. Neil Murphy recommended that SMD collaborate with STMD with regard to CubeSat funding.

Dr. Newmark explained that SMD is science-driven, not platform-driven, and it views SMD platforms and commercial suborbital reusable vehicles (sRLVs) as complementary. In the future, SMD is hoping to use commercial vehicles along with the NASA-managed “core vehicles” to provide flights for payloads. The entire program provides a wide range of flight durations, from 5 minutes to 100 days of observation time, and apogee altitudes from 100-1400 km. The number and range of sounding rocket launch sites (Kwajalein, Australia, Svalbard, White Sands, etc.) allow access to a variety of latitudes and altitudes.

Sounding rocket performance spans a range of altitudes, using vehicles such as Improved Orions, Terrier-Improved Orion, etc. The workhorse is the Black Brant IX (300-400 km), which carries the heavier payloads. The Suborbital program also includes the Balloon Program Office (BPO), which has its main facility in Palestine, TX. A notable accomplishment of the BPO is its recent progress in Super Pressure Balloon (SPB) development. A standard balloon rises and falls, but the SPB is designed to remain at a constant altitude. An SPB has flown for about 40 days over Antarctica; the goal is to fly for months at a time, launching from sites such as New Zealand. It is expected that long duration flights will require overflight permissions from cities/countries in their flight paths.

Airborne Science Program Operations includes a variety of aircraft that look at ice, air quality, and radiation environment in the atmosphere. There are numerous student and training opportunities in the Suborbital program, including project HOPE, which comprises student airborne and student rocket missions. The year 2014 marks the first year of the new SMD CubeSat initiative. There is a single-person panel that represents all the divisions to the AA, who then makes selections for CubeSat launches. Six selections were made this year: HPD had 5 CubeSats selected: IceCube, ELFIN (Electron Losses and Fields Investigation), CuSPP (CubeSat mission to study Solar Particles over the Earth's Poles), TBEx, MinXSS (Miniature X-ray Solar Spectrometer), and SORTIE. MinXSS is now in its flight integration phase and will be deployed from the ISS NanoRacks platform. Dr. Murphy asked if any thought had been given to managing CubeSats under NPD 7120.8 rather than 7120.5e. Dr. Newmark replied that SMD is considering different classification schemes depending on risk tolerances. For MoOs, proposers can claim class C or D, with justification. Dr. Desai asked how NSF CubeSat collaborations are handled. Dr. Newmark explained that for all CubeSat selections, NASA regularly talks with NSF while engaging in two separate reviews. There are slightly different requirements for the two agencies; NSF generally stresses education and has a cost cap of \$900K. Dr. Desai suggested that a Lessons Learned exercise be organized among PIs to review how to collaborate. Dr. Newmark offered to set up a teleconference with the PIs to have meetings every 6 months to share Lessons Learned or to hold a PI-forum event at an AGU session after the first selections fly.

Discussion

Dr. Hagan raised some issues about personnel/staffing at HPD and wanted to hear and understand whether the business of the division is being effectively conducted in light of the recent staffing losses. She also queried the status of the HPD Roadmap. Dr. Tobiska raised the topic of redistribution of funds for PIs, commenting that the community needs more clarification.

Dr. Newmark presented a new organization chart and reviewed the latest management changes. Dr. Bill Paterson is on detail and will be taking over for Dr. Dave Klumpar as Program Scientist for MMS. Dr. Jeff Morel, from NRL, will be backfilling some of Dr. Newmark's previous roles for the next year. There are ongoing discussions with management on bringing on more FTEs; it is recognized that the burden is high on the Program Scientists. Dr. Desai requested data on how many step 2 proposals were discouraged under the new proposal structure. Dr. Newmark reported that, based on 100 proposals to the GI program, last year there was only one discouraged proposal that was then selected. However, the fundamental problem remains funding. The total competed PI-research budget remains at roughly \$60M/year through 2019. Even 'Very Good' proposals are not getting funded. Dr. Antiochos remarked that while the overall budget is unlikely to change much, there is still room to re-balance the program. Dr. Angelopoulos stressed thinking about ensuring future opportunities, and to think of programs that can be utilized toward that goal. Dr. Hagan commented that the top recommendation from the Decadal Survey was to complete the present program. Until that time, there is no real discretionary money to play with. Dr. Angelopoulos suggested augmenting Explorers or funding new opportunities, or creating a small satellite program with more launch opportunities than Explorers - the latter would require planning for when the money arrives. Dr. Newmark commented that HPD could plan around the availability of DoD Evolved Expendable Launch Vehicles (EELV) EELV Secondary Payload Adapter (ESPA) ring opportunities, and hit the ground running when the money arrives.

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Dr. Hagan opened the second day of the HPS meeting.

Interagency Cooperation/Collaboration: National Space Weather Partnership (NSWP) and Solar-C

Dr. Newmark briefed the HPS on interagency efforts, first reviewing science selection principles that have been developed internally at NASA to leverage resources and extend the reach of its science results. Partnership and collaboration are core principles for NASA science. HPD coordinates with HEOMD and APD, ESD, and PSD. Kepler has had some interesting results from which HPD will derive a great benefit, by providing data on stars similar to the Sun, as well as space weather. Data from the Mars Science Laboratory (MSL) RAD (cruise phase radiation monitor) instrument, which was funded by HEOMD, have also proven relevant to HPD. Fundamental physics results from MMS will benefit both APD and HPD, although the two divisions do not jointly fund missions at this time. HPD's Dr. Talaat is also a Program Scientist for MAVEN, so there is certainly interdisciplinary science analysis between PSD and HPD. Dr. Grunsfeld has made collaboration an action item for all Division Directors. There is a mechanism for joint funding between divisions. For example, the Deep Space Climate Observatory (DSCVR) spacecraft will carry instruments for HPD, and also receive funding from ESD (for Earth-looking instruments) and from NOAA (for space weather). Dr. Hagan asked if joint missions were required to abide by Decadal Survey recommendations. Dr. Newmark explained that jointly funded instrumentation fits very well if the science is aligned with the Decadal Survey. As an example, for Mars 2020, HEO is funding an instrument (oxygen-generating instrument). Dr. Liemohn commented that MAVEN is really a space physics mission, but all the data analysis comes out of PSD; can HPD jointly fund data analysis for this mission? Dr. Newmark believed this could be accomplished through the GI program. HPD has funded data analysis from Fermi, as it observed large solar flares.

NSF collaborations have included Living With a Star (LWS) strategic capabilities, CubeSats, future science centers, ground-based facilities, and community-coordinated modeling centers. Communications with NSF have been going very well. The Foundation is very open to collaborative activities, and NASA meets with NSF regularly. HPS was pleased to hear this.

The NASA Heliophysics Space Observatory (HSO) provides near real-time data for Space Weather (SWx). The Van Allen probe has a SWx beacon, as do other HP probes such as Advanced Composition Explorer (ACE), Solar Terrestrial Relations Observatory (STEREO) and SOHO. These provide data to the NOAA Space Weather Prediction Center (SPWC) for operational SWx watches, warnings, and alerts; and to the NASA Community Coordinated Modeling Center (CCMC) to generate modeling and theory products. The NASA role in SWx infrastructure ranges from internal Tracking and Data Relay Satellite (TDRS) system, the LWS Targeted Research & Technology Program (TR&T) program, to the Space Radiation Analysis Group (SRAG). Nationally, NASA has different forecast models such as the geomagnetically induced currents (GIC) Forecast Model, and participates in the National Space Weather Program Council (NWSPC). Internationally, NASA cooperates with the International LWS program and operations in International Space Weather, holds bilateral agreements with Korea, Brazil and Argentina (anticipated), and has regular consultations with ESA. Dr. Antiochos commented that SWx is growing in importance in the UK and Belgium, and asked whether NASA was having discussions with international partners on the issue. Dr. Newmark replied that while discussions are currently informal, ESA has just released their M4 call (2023-25 launch opportunities), for which NASA has sent out a community notice. NASA is planning to provide a letter of support for proposals relevant to heliophysics science, which may lead to a strategic discussion with ESA.

The National Space Weather Program (NWSP) is an interagency initiative that functions under the guidance of the Office of the Federal Coordinator for Meteorology (FCM). The FCM Services and Supporting Research (FCMSSR) program includes 10 member agencies, but is not supported by any funding. The HPD director is a member of the NWSP Council. It is unclear whether there is specific support in Congress for SWx, although the bills of the last few years indicate some interest. The Office of Management and Budget (OMB) and the Office of Science and Technology Policy (OSTP) are very interested in SWx, however. NWSP has a 2010 Strategic Plan that includes the Committee for Space Weather (CSW), which develops the National Space Weather Implementation Plan for a national space weather strategy in coordination with OSTP. Drs. Lika Guhathakirta and Elsayed Talaat are on the CSW, but no new money is expected from this exercise. Dr. Antiochos commented that the real problem had been interagency squabbling; it might be worth asking for extra funding. Dr. Newmark understood the problem, but felt that the likelihood for large increases for heliophysics is not high, and that the best NASA can do is to agree upon a path forward to match requirements and available funds. Dr. Russell felt that Congress sees the urgency when it looks at HPD science and its potential impact on SWx. However, big events are low probability/high impact, which is always a difficult story to convey. Some results have shown that there are significant impacts of daily solar stressing on the terrestrial, effects that are just beginning to be understood. Dr. Antiochos remarked that a coordinated, professional effort to inform Congress of the importance of SWx. DSCVR is an example of the needed measurements, for which funding was obtained as a result of a coordinated campaign; it is critical to get NASA, DoD and NOAA to continue this coordination. Dr. Newmark noted that the key is to formulate a plan and find the

requirements. Dr. Hagan requested a copy of the NWSP Implementation Plan for community comment. Dr. Newmark took an action to get more information to the HPS on the plan.

In other partnerships, NASA collaborates with NSF to produce predictive space weather models. There is also a memorandum of understanding (MOU) between NASA, NOAA, United States Air Force (USAF), the Department of the Interior (DOI) and NSF to work together on implementing space weather policy. Under the aegis of Unified Space Weather Capability, NASA develops operational space weather satellites on a reimbursable basis [e.g., NOAA, Joint Agency Satellite Division (JASD)] for interagency partners, and provides leadership and management of space weather operations related to human space exploration. Heliophysics research provides data for theory and modeling that underlies space weather forecasting.

Key partnerships internationally include ESA and the Japanese Space Agency (JAXA), etc. Missions represented in international partnerships include SOHO, SOC, Hinode, Van Allen Probes, Interface Region Imaging Spectrograph (IRIS), THEMIS, and Magnetospheric Multiscale (MMS). Studies for the JAXA Solar-C mission, a large solar telescope that will provide improved resolution at specific wavelengths, have included US collaborators, some of whom were Hinode researchers. Solar-C is scheduled to launch in 2020. NASA has not yet submitted a proposal, noting that Solar-C is not providing strategic level science as recommended by the Decadal Survey. NASA is enhancing the Explorer line and use of MoOs that may allow participation in Solar-C. Solar-C is also submitting a proposal to the ESA M-4 call, resulting in the possibility of establishing a multilateral discussion between NASA, ESA and JAXA. Dr. Antiochos commented that such a collaboration would be a tremendous way to leverage science by providing instrumentation.

Education and Communication

Dr. Jeff Hayes and Ms. Kristen Erickson provided information on the new Education and Communication (E&C) office at NASA. Dr. Hayes stated that HPD is ready to stand with the SMD front office to support education activities should Congress provide funds, and does have a plan to transition Education and Public Outreach (EPO) from the mission level to a different model based on a Cooperative Agreement scheduled for 2016. Ms. Erickson, newly appointed Director of Science Engagement and Partnerships, described her previous experience in public outreach, having worked with PSD on the Venus transit in 2011, an event that was estimated at having reached one billion individuals. The NASA Venus transit event broke all records of web traffic at NASA, surpassed only by the Curiosity landing in August 2011. The Education portion of E&C comprises activities to enhance learning in the Science, Technology, Engineering and Mathematics (STEM) content areas. Communications is separately defined as a set of functions, such as traditional media, multimedia (social media, web) and traditional public outreach/engagement.

SMD has lost about \$42M/year in EPO over the last few years. In the FY15 President's Budget Request (PBR), stakeholders are now discussing a request of a total of \$21M for E&C. The House has approved \$36M, and the Senate \$48M, in the current bill; it is unclear how the budget request will play out, but NASA is pleased with the Congressional support.

Since 1993, NASA has compiled a well-known track record in education, with proven results. There is bipartisan support for consolidated educational activities across NSF, Smithsonian and the Department of Education; this project is continuing to evolve. NASA recognizes that it is still playing a role in this effort. It is important to note that at NASA, Communications is funded separately from Education. Science Communications is still included in SMD, and missions are working with the Division Directors on Communications, going forward. Ms. Jenny Rumburg confirmed that Communications would not be impacted, that the umbrella Communications group was still in place and welcomed science results from all missions that can be utilized and transformed into outreach.

The NASA Education office is focused on trying to improve US science literacy and maintaining the legacy of past successes, and meeting national education goals while leveraging through partnerships. SMD Education activities will be carried out via a competitive selection by the end of FY15. With regard to US scientific literacy issues, metrics utilized by John Miller indicate that only a third of the US population can answer basic questions about the scientific method; moreover, Mr. Miller has enthusiastically endorsed the role of NASA science in improving scientific literacy. A recently released Committee on STEM (Co-STEM) report has issued specific recommendations and goals, which have been embraced by Dr. Grunsfeld: improve STEM instruction, prepare 100,000 STEM teachers by 2020, increase youth and public engagement, enhance the STEM experience of undergraduates, better serve historically under-represented groups, and design graduate training programs for tomorrow's STEM workforce.

NASA Education also possesses a legacy with Space Act signatories with groups across the US, including a pending agreement with the 4-H Club, as well as alliances with libraries, museums and planetariums. Ms. Erickson presented the schedule for the Cooperative Agreement Notice (CAN), and welcomed as much feedback as possible. The plan is to issue a community announcement by the end of September. NASA is requesting that selectees propose against the science. In 2009/2010, four education forums were selected, representing each division. NASA has extended these forums to help with the restructuring of E&C.

A draft text for the CAN will be released in October, and a workshop will be held in coordination with the National Research Council (NRC) in December. The NRC has been very supportive, and has created a K-12 framework that will help inform the NASA restructuring effort. Award announcements are scheduled for July/September 2015. Dr. Tobiska asked whether E&C has considered extending its concept to the professional education arena, for scientists and engineers. Ms. Erickson replied that the science education community is the only one targeted, but agreed that the model could be utilized more broadly for other applications, such as professional development of scientists and engineers. If someone proposed the idea as an element in the competition, it would not be precluded from consideration.

As a notional approach to SMD Education content, legacy items such as Global Learning and Observations to Benefit the Environment (GLOBE), the Hubble Space Telescope (HST), and the Mars program will continue. The scope will include content associated with future missions such as Mars 2020 and cross-divisional science such as exoplanet exploration. MMS education science will also transition into the CAN. After missions pass Senior Review, their science will be included in the CAN scope. As to

mission Communications, there will be no change. Dr. Hagan commented that it seems that one element that has led to NASA's historical success was close work between EPO professionals and the mission scientists, and asked if this practice would transition as well. Ms. Erickson absolutely agreed and had no intention of breaking these relationships. Efforts are also under way to have some amount of money allocated to the scientists and engineers to ensure that science data can be more easily translated into educational content. There will be a push-pull dynamic, and every Division Director is supportive of this philosophy. In the CAN, there will also be language, currently under development by HPD, to address space weather themes.

Ms. Erickson summarized the presentation by highlighting the importance of understanding that education is a complex environment, which requires maintenance of personal connections. It is important to have scientists talk to the public and engage their interest. Ultimately it is the student-teacher connection in K-12 that translates to success, and NASA doesn't want to lose sight of that connection.

Discussion

Dr. Angelopoulos asked if there was still a percentage level (1%, historically) for each mission for covering Communications. Ms. Erickson replied that this practice was still to be determined. Dr. Newmark noted that HPD Communications would be putting out guidance on how to move forward, but that there has been no specific allocation yet. There will not, however, be a fixed percentage across the board as in past practice. Within the divisions, there will be an ability for staff to support the CAN providers. How this will be done is at the discretion of the Division Directors. The goal is to have an adaptable system. Dr. Angelopoulos note that some of these products require time and resources, and that it would be good to be able to charge hours specifically to Education. Dr. Newmark explained that the policy is that all one needs is the approval of a supervisor to work on Education activities.

HPS Final Work and Voting

HPS discussed GPRAMA inputs with Dr. Kessel. The subcommittee then voted on grades for each strategic objective.

API HE-14-1 Demonstrate planned progress in exploring the physical processes in the space environment from Sun to Earth and throughout the solar system.

Grade: Green- Subcommittee vote was unanimous.

API HE-14-4 Demonstrate planned progress in advancing understanding of the connections that link the Sun, Earth and planetary space environments, and the outer reaches of the solar system.

Grade: Green- Subcommittee vote was unanimous.

API HE-14-7 Demonstrate planned progress in developing the knowledge and capability to detect and predict extreme conditions in space to protect life and society and to safeguard human and robotic explorers beyond Earth.

Grade: Green- Subcommittee vote was unanimous.

Division Director De-Brief

The subcommittee briefed Dr. Newmark on its GPRAMA voting results. Dr. Hagan noted that the HPS had no mature findings to announce at this time, but that some ideas were in gestation: planning in the outyears for program balance; proposal pressure and the community impact of reviews; support for space physics for non-HPD missions; and interest in the NSWP Implementation Plan. Dr. Antiochos commented that another issue is how to improve the NASA/NOAA partnership, and suggested that HPS invite Tom Berger to speak at the next meeting.

HPS finalized its GPRAMA documentation and made tentative plans for the next meeting in late winter/spring, ideally in advance of the Science Committee and the President's budget announcement in February. Dr. Murphy suggested that retiring HPS members extend their membership for 6 months. Dr. Hagan adjourned the meeting at 3:30 pm.

Appendix A

Attendees

HPS Committee members

Maura Hagan, Chair, National Center for Atmospheric Research
Vassilis Angelopoulos, UCLA, Jet Propulsion Laboratory
Spiro Antiochos, NASA Goddard Space Flight Center
Mihir Desai, Southwest Research Institute
Jeffrey Hughes, Boston University
Mike Liemohn, University of Michigan
Ralph McNutt, Johns Hopkins University
Neil Murphy, NASA Jet Propulsion Laboratory
James Russell, Hampton University
W. Kent Tobiska, Space Environment Technology (telecon)
Elaine Denning, NASA HQ

NASA Headquarters

Marc Allen, NASA HQ
Ralph Beaty, NASA HQ
John Cooper, NASA GSFC
Ann Delo, NASA HQ
Kristen Erickson, NASA HQ
T. Jens Feeley, NASA HQ
Timothy Gehringer, NASA GSFC
Lika Guhathakirta, NASA HQ
Jeffrey Hayes, NASA HQ
Jennifer Holt, NASA HQ
Jennifer Kearns, NASA HQ
Mona Kessel, NASA HQ
Robert Leamon, NASA HQ
John Lee, NASA HQ
Jeffrey Newmark, NASA HQ
Jeff Nunn, NASA HQ
William Paterson, NASA HQ
Arik Posner, NASA HQ
Boleak Rouem, NASA HQ
Jenny Rumburg, NASA HQ
Mike Seabloom, NASA HQ
Sandra Smalley, NASA HQ
Joseph Smith, NASA HQ
Elsayed Talaat, NASA HQ
Dan Woods, NASA HQ

Non-NASA attendees

Arthur Charo, National Research Council
Dan Leone, Space News
Allen Li, House Science, Space and Technology Committee
Alan Keisner, Space Exploration Technology

Linda Karandan, Aerojet Rocketdyne
James Lochner, USRA
William Paterson, Wm. PA
Josh Shiode, American Astronomical Society
Sasha Ukhorskiy, Applied Physics Laboratory
Ana Wilson, Zantech IT
Joan Zimmermann, Zantech IT

Appendix B

Subcommittee Membership

Maura Hagan, Chair HPS
National Center for Atmospheric Research

Vassilis Angelopoulos
University of California at Los Angeles

Spiro Antiochos
NASA Goddard Space Flight Center

Jill Dahlburg
Naval Research Laboratory

Mihir Desai
Southwest Research Institute

W. Jeffrey Hughes
Boston University

Michael Liemohn
University of Michigan

Ralph McNutt
Johns Hopkins University

Neil Murphy
NASA Jet Propulsion Laboratory

James Russell
Hampton University

W. Kent Tobiska
Space Environment Technology

Ramona Kessel
Executive Secretary
NASA Headquarters

Appendix C

Presentations

1. Heliophysics Division Status; *Jeffrey Newmark*
2. Heliophysics Division Flight Program Status; *Sandra Smalley*
3. FY14 Heliophysics Subcommittee Performance Assessment; *Ramona Kessel*
4. Rotationally Driven 'Zebra Stripes' in Earth's Inner Electron Belt; *Sasha Ukhorskiy*
5. Heliophysics Division Organization and Research Program; *Jeffrey Newmark*
6. NASA SMD Suborbital Research Program; *Jeffrey Newmark*
7. Heliophysics Collaboration and Coordination; *Jeffrey Newmark*
8. NASA SMD Education; *Kristen Erickson*

Appendix D Agenda

Heliophysics Subcommittee Meeting September 23-24, 2014

Tuesday September 23; 6H41

8:30 Subcommittee Room Open

9:00 Welcome, Overview of Agenda

M. Hagan, HPS Chair

9:15 Heliophysics Division Overview

J. Newmark, NASA HQ

9:45 Flight Program Status

S. Smalley, NASA HQ

10:15 BREAK

10:30 Discussion with Associate Administrator for SMD

J. Grunsfeld, NASA HQ

11:00 Heliophysics Science Performance Assessment
Input the FY2014 NASA PAR – Overview

M. Kessel, NASA HQ

11:30 Heliophysics Science Performance Assessment, input for
the FY2014 NASA PAR – Review and Assignments

Subcommittee

12:30 LUNCH: Science Presentation: Sasha Ukhorskiy/APL, Rotationally Driven “Zebra Stripes” in Earth’s Inner Electron Belt

1:30 Subcommittee work session(s)

Subcommittee

3:15 BREAK

3:30 LCAS strategic and budgetary priorities
(Cubesat Initiative)

J. Newmark, NASA HQ

4:30 Subcommittee work session

Subcommittee

5:00 ADJOURN

Group Dinner